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Intellectual disability and social cognition

Studies in social cognition in adults with moderate intellectual disability by eye-tracking technique

Theses of Ph.D. dissertation

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THEORETICAL BACKGROUND

Intellectual disability (ID) in psychology of special needs

In Hungary it was Ágnes Engelmayer Lányi who introduced the concepts of intellectual disability, and developmental disorder into the literature on atypical development. In her monograph *Intellectual disability and psychological development* (2009) she offered Hungarian translations for these terms, which followed recent conceptions and terminology used in the international literature.

In accordance with internationally accepted definitions and classification, people with intellectual disabilities share three key characteristics:

1. Impaired intellectual functioning (below IQ 70): this criterion emphasizes and clarifies the intellectual nature of the disability. The intellectual deficit, however, does not exist in a vacuum.
2. Deficits in adaptive functioning, or in the skills needed for daily activities associated with personal and social self-care. These include the ability to communicate their needs to others, routines of daily living (eating, dressing, hygiene, etc), as well as the socially acquired abilities to follow instructions, obey rules, and work and play with others.
3. Early onset: this criterion distinguishes the intellectual disability from degenerative disorders with onset in adulthood (e.g., Alzheimer's disease) and from adult brain injuries (HODAPP; DYKENS, 2003).

Intellectual disability is an umbrella term, covering a variety of heterogeneous conditions. It may arise as a symptom of some other developmental disorder, but it may also appear as an autonomous syndrome or developmental disorder. It has no uniform etiology. However, all types of ID are neurocognitive developmental disorders affecting a variety of neural structures, thus leading to atypical organization. Anatomical structures, physiology, behavior, and psychological processes (including both cognitive, and affective functioning) may also have atypical organization in varied patterns (GYŐRI, 2012).

Thus the etiological factors may result in various patterns of cognitive ability, developmental dynamics, and prognoses. A number of factors interacting in different ways can lead to the development of intellectual disability. Due to the interactions of genetic andother biological, environmental and psycho-social risk factors, researchers recently propose a "multifactorial" etiological model of cognitive disability. Certain factors can lead to the development of intellectual disability in themselves, but the clinical characteristics, severity and behavioral

effects almost always arise as a result of combined risk- and protective factors (VIG; SANDERS, 2007).

Contemporary human behavioral genetics is an interdisciplinary field that uses genetic methods to uncover the origin of individual differences in human behavior, and studies the complex gene-environment interactions. It has also contributed significantly to our understanding of intellectual disability. The three main etiological factors that underlie intellectual disability are:: (1) chromosomal and gene abnormalities, (2) polygenic background factors, and (3) non-genetic factors (GYŐRI, 2002). Innovations in molecular and behavioral genetics in the past few decades offer powerful tools for accurate identification of causes of type (1) and (2); they also help to reveal the etiological factors responsible for cases earlier classified as ”familial” ones. They also suggest novel explanations for the interaction between hereditary and environmental factors (IAROCCI, PETRILL, 2012).

For a long time it was thought that the incidence of intellectual disability in the general population may be as high as 2.5-3%, but this estimate has changed substantially in recent years. For example, Reynolds et al. (2012) suggest, based on IQ measures, that the incidence of intellectual disability in the USA is about 2.5%; of which 10% is moderate, 3-4% is severe, 1-2% is profound. However, if we add impairments of adaptive functioning and behavior to the diagnostic criteria, criteria, the frequency drops below 1%. In addition to the diagnostic criteria it is important to take into account potential *associated problems* as well.

Associated problems may include (1) mild deficiency in other psychological functions (e.g. perceptual and motor abilities) which accompany the low level of intellectual and adaptive functioning, but do not themselves reach the disability threshold; and (2) the accompanying disabilities (perceptual, motor, etc.) and/or physical and psychiatric disorders. The number and severity of associated problems correlates with the severity of the intellectual disability. The associated problems significantly influence the overall clinical picture and have an impact on psychological and behavioral performance, increasing further the variability within the intellectually disabled population.

Social cognition in intellectual disability

Social cognition is a summary term for the cognitive processes that underlie social behavior. Initially it was meant to refer to a naïve theory of mind and the concepts it involved; later on, the term acquired a broader meaning. Now we take it to include all the cognitive capacities underlying social behavior. It is of essential importance that humans are able to think about

each other and the social world, and are able to understand themselves and others as conscious beings, having internal mental states. This general capacity is meant by the term *social cognition*. The development of social cognition has been a subject of very intensive research in the past 30 years including both typical and atypical development (SHARP, 2008). The definition currently used for intellectual disability highlights the relative difficulties in social adjustment in addition to substantial cognitive deficits. This generic term covers several aspects of finding one's way in the social world: helping oneself, assertive behavior, cooperation, and so on; it also includes complex perceptual and interpretive social-cognitive processes, which form the basis for social behavior and social learning (CEBULA et al., 2009). If we compare the literature on the typically developing population and autism spectrum disorder (ASD) (plus, in recent years, WS) on the one hand, and other types of intellectual disability on the other, we find many more publications addressing social cognition in the former than in the latter group. In addition, , publications in the latter group mostly focus on childhood. This is perhaps because, as CEBULA (2009), puts it, social cognition is the "little brother" of general cognition, and general cognitive factors explain more of the difficulties that the intellectually disabled face in everyday life; therefore social cognition receives less attention.

In intellectual disability, the connection between general cognition (general disability), and social cognition may be direct (weakness of attentional functions, memory, and executive functions, such as maintaining attention, ignoring irrelevant information, and selecting relevant one , flexibility and attentional shifts etc.), and indirect (weaker cognitive performance, limited social recognition and success,, predominantly negative social experience), or an interaction of these.

One of the possible mediators between cognitive functions and successful behavior in everyday life is social cognition, which encompasses mental processes behind social behavior (MARTON, 2012). Social cognition is intimately related to other cognitive functions. For this reason it is worth looking at the role of low-level visuo-motor processes (in particular, eye movements) in social perception, including its typical and atypical forms. In addition to studying eye movements, I also propose to examine how basic visual perceptual processes, and more complex cognitive processes affect the perception of social information.

EXPLORATORY RESEARCH QUESTIONS

The studies to be presented in this work are exploratory ones, in two different senses. First, the assessment of cognitive characteristics that define intellectual disability on the one hand, and the study of eye movements, mentalization skills, and social interpretive ability on the other, are both based on methods that so far have not been applied in Hungary. For assessment of intellectual disability we used the WAIS-IV and SIB-R tests; for studying eye movements and social skills we used eye-tracking, the Frith-Happé animations, and the Yarbus paradigm. Second, we attempt to provide a bird's-eye view of the phenomena and problems within the field of intellectual disability and social cognition, and to highlight possible foci for further research. This explorative approach is also motivated by current international research in the field.

Our aim is to collect data, explore basic facts, and formulate hypotheses for further investigation within the broad field of intellectual disability. We shall also present some conjectures and speculations (indicating their status as such) that have arisen in the course of the present research, whose aim is to jointly explore the fields of eye-movement and social cognition in intellectual disability.

As we mentioned above, intellectual disability can be considered a comprehensive neurocognitive developmental disorder, which, in addition to its core intellectual and adaptive behavioral deficits, also includes several other cognitive (perceptual, linguistic, attentional, memory-related) and social difficulties. Of central importance for our purposes is exploring the complex relationship between intelligence indices, adaptive behavior, eye movement in visual perception, and social cognition; in general, to improve our understanding of the link between social cognition and other cognitive processes. Overall we expect a significantly poorer performance in all fields compared to the typically developing population; this difference will be explored further when we discuss the specific research questions addressed by our experiments. However, additional interesting questions arise from the explorative analysis of the applied methods.

In this thesis we address the following five main questions (each of which will be discussed below, when we describe the studies to address them):

1 **Can we apply the Hungarian version of the *Wechsler Adult Intelligence Scale - Fourth Edition (*WAIS-IV) for intelligence assessment of persons with ID, and can we compare the results of the Hungarian and American subjects examined?**

The WAIS-IV test is a recently introduced one in the psycho-diagnostic practice in Hungary.Its goal is to provide a detailed picture of the IQ structure of our samples, including subjects with intellectual disability. It is expected that the test functions well in the low IQ range, and may be a suitable device for examining the structure and level of intelligence of adults living with intellectual disabilities. We make this assumption on the basis of the American data published by SATTLER et al. (2009), LICHTENBERGER et al. (2009), and WEISS et al. (2010). According to these authors the IQ indicators of subjects with moderate intellectual disability fell into the expected area when tested with WAIS IV: full scale IQ 48.2, with index values between 53.1 and 56.8). We think it is important to obtain test results under controlled conditions; since the process of adaptation in Hungary did not involve clinical groups, we do not yet have data from subjects living with moderate intellectual disability.

We are interested in the level and profile of intelligence of the ID population. Since in Hungary biographical records of ID adults are rarely collected, it was necessary in the present research to assess the actual level of intelligence (and adaptive behavior) under controlled conditions and by valid and reliable procedures. Three more specific research questions were: (1) the efficacy of assessment by the WAIS-IV in the ID population, as the Hungarian version has not so far been used in systematic studies on this group; (2) the internal coherence of the intelligence indicators; and (3) the comparison of the obtained data to those in the international literature.

In the study with WAIS-IV on adults with moderate ID the following hypotheses were investigated:

A) We expect to obtain IQ indicators and profiles in accordance with international findings. The Hungarian test adaptation should work in the same way for a Hungarian sample as the American version for an American sample (LICHTENBERGER et al., 2009; SATTLER et al., 2009; WEISS et al., 2010).

B) We predict that the full scale IQ (FSIQ) of our subjects will be between 55 and 40 (lower full scale IQ cannot be measured by this test) (SCHALOCK et al., 2010)

C) We also expect to find subjects whose performance in certain subtests (or indices) cannot be measured reliably, as they get a value score of 1 for a raw score of 0 due to their FSIQ being below 40 (the moderate IQ range is between 55 and 35) (WHITAKER, 2010b).

D) Finally, we assume that Working memory (WMI) and Processing speed indices (PSI) will be lower than Verbal comprehension (VCI) and Perceptual reasoning indices (PRI). A large part of our sample comprises adults with Down syndrome (DS) who are known to have short

term memory problems (JARROLD, BROCK, 2012; JARROLD, 2008; JARROLD; BADDLEY, 2001) and difficulties with numerical cognition (the two working memory subtests rely heavily on numbers) or slowed psychomotor tempo (the two subtests measuring processing speed have time limits).

2 Is it possible to use the *Scales of Independent Behavior - Revised* (SIB-R) to assess the adaptive behavior of subjects with ID? How do the results compare to intelligence indices and related findings in the international literature?

In the international psychological assessment practice several procedures are known for measuring the adaptive behavior of subjects with intellectual disability. However, there is no up-to-date, standardized procedure available in Hungary still it is essential to extend the protocol in this direction in order to match the three criteria of intellectual disability given above, and to compile individual education plans for subjects with ID. The results of studies using SIB-R in the special population are promising (CSÁKVÁRI, 2010). It seems to be a suitable tool for measuring the independence of behavior, and the assessment of adaptive behavior profile. Data by BRUININKS et al. (1996) on clinical samples help us interpret the results obtained in our own study. We wish to examine whether the results obtained using the unstandardized Hungarian version indicate significant adaptive behavior impairment in subjects with moderate ID (according to their IQ scores), and also whether we obtain in our study the expected high correlations between the SIB-R subscales on the one hand, and between IQ and adaptive behavior scales on the other..

Assessment of the quality of adaptive behavior is essential for a diagnosis of ID. We needed to measure the level of adaptive behavior, because the existing records of our subjects did not contain any information about it. The primary aim of this study was to collect data concerning adaptive behavior that is both comprehensive and specific to particular subfields. A secondary aim was to try a method for examining adaptive behavior on a sample of Hungarian subjects with moderate ID. The relationship between indicators of adaptive behavior and those of eye-tracking is discussed below in the section about eye-tracking. With respect to adaptive behavior, we make the following predictions:

A) The clusters of adaptive behavior and the overall independence standard score will be below average by at least three standard deviations, that is, we expect the results to fall within the range of 55-30 (BRUININKS et al., 1996).

B) Adaptive behavior is a consistent construct, we should expect significant correlation between each of the clusters. Only a study on persons with visual impairment and profound

multiple disabilities has so far been conducted with this tool in Hungary (CSÁKVÁRI, 2010), therefore we investigate the results of the ID population on the basis of international literature. Based on the US and Korean standardization sample data the correlation between certain clusters of the scale both in the typical and atypical (ID) population is significant (0.63-0.89) (BRUININKS et al., 1996; CHO et al., 2010).

C) It is assumed that the level of adaptive behavior and intelligence correlate strongly, as both are ID criteria,(only in the case of *significant impairment to both* can we talk about ID). As in the case of IQ, we expect significant impairment of adaptive behavior in the moderate ID range (SCHALOCK et al., 2010).

3 Exploring the ID specific features of visually guided saccade (VGS) given to simple geometrical stimuli. (VGS is one of the basic eye movements forming the basis of the visual perception and information processing)

Social cognition is not independent of other functions. We have to mention here the role of the low level of visual-motor processes (eye movement) in social perception and its atypical appearance, the significance of elementary visual perceptual processes and the characteristics of higher level cognitive processes affecting the perception and processing of social information.

Due to the high frequency of visual problems in ID population it was necessary to collect data on the basic characteristics of eye movement by eye-tracking technique. Several findings (though considerably fewer compared to those for other populations) have been published on researches with ID samples using this technique. These studies, however, did not involve persons with Down syndrome (DS) in the research, so basic eye movement data is not available for this syndrome (having searched on Scholar Google and Web of Science).

We can pose our own questions on visually guided saccades based on two antecedents: (1) for the latency of visually guided saccades the HAISHI et al., LASKE et al. and TAKAHASI et al. publish findings (quoted by HAISHI, 2011) based on an non-specific ID population. The findings are not congruent, in part reporting increased saccade latency in connection with intellectual level, in part demonstrating typical saccade reaction time. (2) The study of van der GEERST et al. (2004) investigating the characteristics of saccade amplitude in Williams syndrome (WS) reports a high level of dysmetria in this syndrome.

Among our participants DS is over-represented, because of this we considered it essential to describe the basic characteristics of eye movement from an explorative viewpoint before discussing the more complex paradigms concerning social cognition. In DS the major

ophthalmological difficulties are known, so in a sense the eye-tracking technique can even be considered inadvisable, as existing studies have not demonstrated its usability. In our current research we would like to confirm that the eye-tracking technique is appropriate for this population (which might function in everyday life with a high level of adaptability), the ID saccade characteristics securing the visual sampling of the surroundings that can be identified with the participation of persons with DS. We matched typically developed (TD) adults for control.

As there is little data available concerning the application of the eye-tracking technique with ID, and that which is available is controversial, we have presented assumptions about the quality of the data and the specificity of methodology in the study of basic eye movement.

A) Due to the over 65% occurrence of ophthalmic problems in the ID group and the difficulties encountered during calibration, we expected a significantly higher percentage of missing sample and less recorded data than with the TD group.

B) It is assumed that among the eye movement indicators forming the basis of visual perception and information processing the VGS characteristics given to elementary physical stimulus show atypical and ID-specific features. We expect:

a) more irrelevant VGS due to the known ophthalmologic difficulties and eye movement problems (CHALAM et al., 2011, SKUTA et al., 2011)

b) increased saccadic reaction time (based on HAISHI et al, 2011, 2013) and

c) less accurate saccade reception (based on van der GEEST et al, 2004).

During the descriptive, explorative analysis we study the amplitude of the saccades, their duration, speed and accuracy, and making comparisons between the ID and the typical groups.

It is assumed that there are oculomotor (physiological, anatomical) and cognitive limitations which contribute to a globally weaker intellectual and adaptive functionality (the present study does not state whether they are causes and/or consequences, as the primary aim is to illustrate the existence of the phenomenon and seek a better understanding of its characteristics), and it is important to identify them, thus demonstrating the worth of the eye-tracking technique as research and supporting technology.

4 Exploration of theory of mind ability and emotion attribution processes, considered to be the fundamental building blocks of social cognition, with the *Frith-Happé animations* by eye tracking method

The study of theory of mind in ID has not yet been conducted using the Frith-Happé animation, while in other atypical populations (ASD and schizophrenia) the procedure has proved to be usable, the findings of the eye-tracking technique detecting some difference between the eye movement indicators given to social and non-social stimuli, these differences in the atypical populations differing from those obtained in the typical population.

It is claimed that observing static stimuli or while reading, the fixation duration can be sensitive indicators of the depth of processing (GILCHRIST, 2011, HENDERSON, 2011), and the same findings were confirmed by the studies using dynamic animations with typically developing (KLEIN et al., 2009) and ASD participants (ZWICKEL et al., 2009).

In the current study we wanted to know if there was an ID-specific eye-tracking (temporal and spatial features of fixation) and verbal answer pattern for social and non-social stimuli which is significantly different from the same (eye-tracking and verbal) answers given by typically developing individuals; and from the existing results in the literature on ASD.

In the current study we want to examine the following assumptions based on earlier international findings employing the Frith-Happé animations by eye-tracking technique:

A) It is possible to collect relevant information from persons with ID about emotional attribution aspect of social cognition using the Frith-Happé animation by eye-tracking technique. In ASD (ZWICKEL et al., 2010), and in schizophrenia (RUSSELL et al., 2006) the method was usable but with persons with normal or corrected-to-normal vision. We presented the high incidence rates of ophthalmic problems in ID, but on the basis of the successful conducting of the VGS tests we assume that we will also obtain assessable eye-tracking data with the Frith-Happé animations.

B) It is assumed that in ID group the data-quality would be worse than in TD control. The underlying factors behind worse data-quality still persist in the study to the same or an increased extent (compared to the VGS stimuli): these due to ophthalmic problems in the ID group, and/or to more complex task.

C) In the aforementioned study by KLEIN et al. (2009) with typically developing individuals and persons with ASD (ZWICKEL et al., 2010) significantly longer fixation was observed during the social scenes than in the goal-directed and non-social scenes. The longer fixation was interpreted as the eye-movements manifest deeper cognitive processing. It is assumed that both in ID and TD groups we will find this pattern in our own investigations.

D) Social scenes allow for the attribution of mental states, which is also observable in the verbal responses (ABELL et al., 2000, WHITE et al., 2011). According to the results of the above-mentioned authors and other ID-related findings of theory of mind ability (CEBULA et

al., 2009, GIAOURI et al., 2010), we would expect more inaccurate categorization and emotion attribution in ID group than in TD group. We assume that the social condition will be more difficult to categorize for persons with ID.

5 Examination of task dependent (top-down) scan-path on static, visual, social stimulus in persons with ID. Examination of the ID-specific saccade and fixation characteristics by eye tracking technique

Our study also concerns the ID-specific characteristics of social cognition with the "re-use" of a classic eye-tracking paradigm. YARBUS (1967) is one of the founders of modern eye movement research. His classic question is what impact the instruction received by the observer has on eye movement. In our study we examine whether it is usable to analyze the top-down processes of social cognition. Our explorative question is firstly whether the findings of the original paradigm previously conducted on ID (BAZAR, 2009) and ASD groups (BENSON et al., 2009, 2011) can be repeated. Secondly, with additional intention- and emotion attribution tasks, we assume a significant difference in saccade characteristics and fixation duration between persons with ID and TD on the human heads area of the stimulus.

A) In a qualitative analysis of scan-paths based on the results of BAZAR (2009) we expect that the scan-paths of people with ID and TD both show a task-dependent pattern and reflect goal-directed processing, as top-down effects of visual selection are to be seen in both groups.

B) In the quantitative analysis we expect the following:

a) Subjects with ID will scan the stimulus with slower saccades and less fixation than subjects with TD (based on the results of our VGS and Animation studies),

b) Between the TD and ID groups in the social task condition (BENSON et al., 2009, 2011 on an ASD sample; and our Animations study, according to results expected and obtained from other social stimulus material) the fixation durations differ greatly, being lower in the ID group. In the TD group, longer fixation is the sign of a deeper processing, while in the ID group this socio-cognitive processing is less evident at the level of fixation.

c) In the ID persons' fixation patterns given to "heads" and outside areas no difference is expected between social and non-social task conditions, while in TD group it is, as the "heads" region is an outstanding area in social task conditions (more and longer fixation). We base this prediction on the findings of BENSON et al. (2009) on the basis of their ASD sample, and although these are two different groups, we believe such a pattern to be possible based on previous data indicating weak theory of mind ability in ID.

STUDIES

1 ASSESSMENT OF INTELLIGENCE - WAIS-IV

40 adults and adolescences with ID participated in our research study (57.5% male). The sample contained persons attending education or day care institutions and living in residential homes or with families. Some of them were working in the open labor market or in supported employment. They were diagnosed from childhood with moderate ID by one of Hungarian Expert Commissions (ICD-F71 code).

Since some of the data from the U.S. testing carried out on an ID sample is at hand, it is worth comparing it with the Hungarian findings (Fig.1.). The profile patterns are similar, the Perceptual reasoning index scores match and the scores of the Working memory and Processing speed indices are also almost the same. In the case of the Verbal comprehension index and full scale IQ there is significant difference, the Hungarian group being weaker in these indicators.

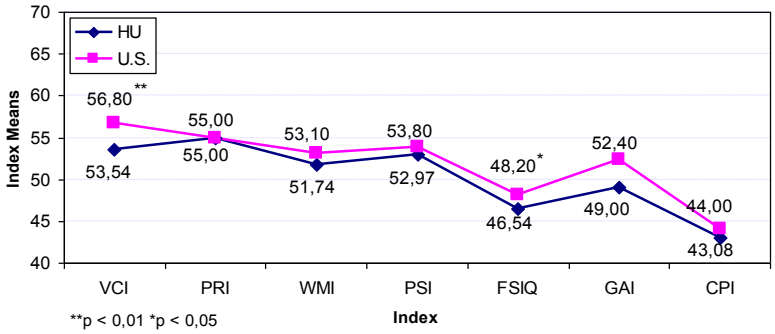


Fig. 1 Index means and FSIQ in the WAIS-IV based on the samples of Hungarian and American adults with ID

The results of the investigation show that the WAIS-IV intelligence testing procedure can also be used successfully with adults with ID. It is possible to interpret the results according to the test protocol, as the difficulties associated with assessing this special population (e.g. the floor effect) are manageable. The results support the hypothesis that the cognitive features of ID cannot be characterized by one index, only on the basis of IQ. Although the average FSIQ is indeed within the expected range between 40 and 50, significant differences are found within the intelligence profile indicators. Beside the relatively strong VCI and the PRI we found significantly lower working memory and processing speed performances, which is not surprising because of the operational difficulties in implementing them for subjects with ID, but which is also a remarkable achievement from the point of view of research and practice.

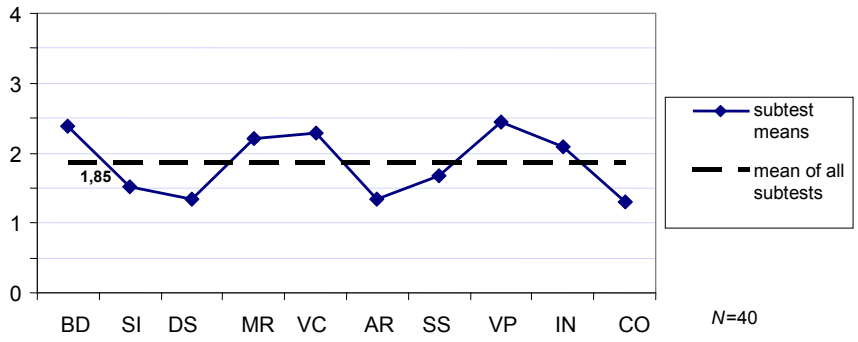


Fig. 2 Relative strengths and weaknesses of the Hungarian adults with moderate ID – current study

The WAIS-IV intelligence scale is a useful instrument for the overall measurement of cognitive abilities in the Hungarian adults with ID.

2 ASSESSMENT OF ADAPTIVE BEHAVIOR - SIB-R

31 persons in all participated in the examination (58.1%, 18 men), the sample overlapping with the persons involved in the WAIS-IV examinations, 29 persons having both WAIS-IV and SIB-R results as well, while one person was not included in the WAIS test (as he was not available), and from the performance of other person TtIQ could not be calculated.

The process allows a multi-level analysis and interpretation of the results. When interpreting the results we must acknowledge that they may be culturally different in that the subjects' age may play a role in the performance we expect on a given area of adaptive behavior, so the age-and equivalent value, the relative skills index and the standard score (with which we also work in our own examination, as we lack domestic norms) can only be interpreted with this in mind.

We found it promising that according to the sample of persons with moderate intellectual disability the results they obtained fell into the previously expected field of values, except for the cluster of community life. (Fig. 3)

The value of the cluster of community life standard score is significantly lower compared to the others, although the equivalent value for the age is higher within the motor cluster. It is conceivable, however, that due to the lack of examinations performed on Hungarian typical samples it cannot be decided whether in this area the expectations may not be higher in America for the given age group, than in Hungary.

By and large, the results obtained from the measuring of the adaptive behavior of the SIB-R scale are promising, and even if we lack domestic standards, the results aid the examination of the behavioral profile and the identification of strengths and weaknesses. The significantly

high correlation of the results for behavioral independence with those of the IQ calculated according to the standards formed in the Hungarian sample makes it clear that in the population with intellectual disability the present variant of the SIB-R scale also gives valid results, hence there is an urgent need for its domestic standardization.

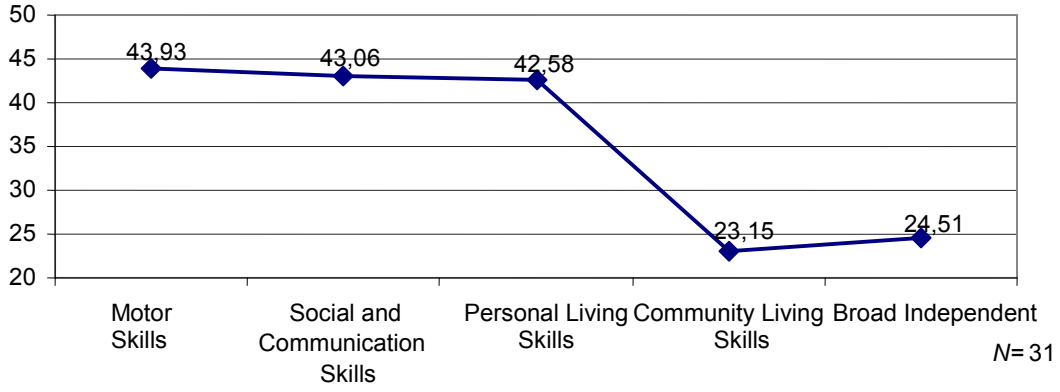


Fig. 3 SIB-R clusters mean Standard Scores in adults with ID

It must be highlighted in the results that the intelligence indicators and the social, communication area appear significantly connected. Without supposing for the moment any explanation for this, it is worth emphasizing in the case of intellectual disability the close correlation between intellectual functioning, behavioral independence and conformity, and social and communication skills, as this gives us a more thorough understanding of intellectual disability and has an effect on our practice, and what is more, it may equally designate further research and open up new directions of intervention.

EYE TRACKING STUDIES

The common conclusion of more examination of eye tracking performed with persons with intellectual disability is that this procedure can be used for this population and can be evaluated, and different results are generated with typically developing groups. Using this procedure with persons with intellectual disability has the following special advantages:

1. The design of the research makes it possible for us to take into account the features of special needs, and the associated problems of the examined population (e.g. difficulty in verbal understanding, short attention and lack of speech
2. The applied stimuli can be very well fitted to the subjects' age and to the severity of the condition;

3. Tasks in the follow-up activities are generally easily understood (in some cases looking at the display is the task itself);
4. Relatively simple response behavior is expected (see above: watching a display is the only task).

The eye tracing method can be used in several applied fields, and likewise with people with intellectual disability as well. A well constructed research design may be suitable *for predicting* memory impairment, early dementia or Alzheimer's disease (CRUTCHER, et al., 2009). For filtering slight, not obvious cognitive disabilities (LAGUN et. al., 2011), a fundamental basic question regarding this population concerns treatment-specific factors (e.g. drugs and their side effects acting on the central nervous system) and the objective monitoring of relationships between the various central behavioral characteristics *(*FARZIN, et al., 2011).

In the three eye-tracking studies we examined 38 adults with intellectual disability (within an age range of 17 years and 6 months to 41 years and 1 month), and a number of 40 typically developing (TD) adults (within an age range of 18 years to 39 years and 1 month). We included adults with Down syndrome, Williams syndrome and fragile X syndrome in the intellectual disability sample, and in both the latter two syndromes we included 3 persons for pilot testing. We did not conduct any syndrome-specific research. As in the international literature the eye-tracking examinations of persons with intellectual disability are few, and because the cumulative assessment of persons with differing etiology of intellectual disability is also relevant we carried it out in our examination as well, and while processing the data we treated people with intellectual disability as one group.

3 VISUALLY GUIDED SACCADE (VGS)

The saccadic sampling of the visual environment is a basic characteristic of the functioning of the visual system. We call saccades the quick, ballistic movements of the eye (the saccade trajectory, once it has been started, and the place of its arrival cannot be changed, so the object that is followed by the eye in the visual field must be selected before starting the saccade).

During the tracked saccades in the applied task the saccades differed significantly in the two groups, with regard to every examination. In the intellectual disability sample the times of the saccades are longer and their general amplitude is shorter, their average speed is shorter, their arrival at the point of the stimulus is inaccurate and the final point of the saccade is farther from the central point of the stimulus, than in the TF group.

The time span of the VGS (is longer) and the amplitude (is shorter) for persons with intellectual disability, and differ significantly from those of the TF group, their arrival point being significantly more inaccurate, yet we cannot see any significant difference in the saccade reaction time, although the persons with intellectual disability started the saccade slightly quicker. The data of the professional literature is contradictory in this respect, but we have not received any prolonged reaction time results in our examination (as in the case of, for example, HAIKISI, 2001).

4 FIXATION FEATURES, EXPLICIT ATTRIBUTION OF MENTAL STATES AND AGENCY PERCEPTION IN DYNAMIC GEOMETRICAL STIMULI - FRITH-HAPPÉ ANIMATIONS

The original animations consist of 12 short films introduced by 3 practice films. In all animations there are two animated triangles, a larger red one and a smaller blue one. The triangles perform different movements. In the original versions the films are 34 and 45 seconds long, but KLEIN et al. (2009), and ZWICKEL et al. (2010) used a shortened 18 second version in their studies, which we also used in our study.

The films show 2 types of "connection" through the patterns of their movement:

(1) In the version originally called “random”, the moving triangles do not touch, and so they do not affect each other's path (the "non-social" NS condition);

(2) In the version originally called “theory of consciousness”, as cited by TOM in international publications (in our research called the "social” S condition) the movements are "as if living", thus not following the physical rules of the movement for lifeless bodies

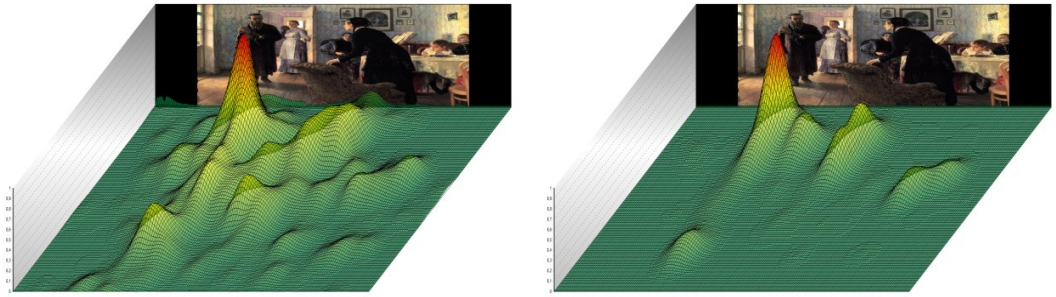
In the case of both NS and S stimuli in the ID group compared with the TF group we observed less fixation, the average duration of fixation for NS ($t = -15.00$ $p < 0.001$) and S ($t = -12.45$ $p < 0.001$) stimuli being significantly shorter.

5 TASK DEPENDENT SCAN-PATH IN THE PERCEPTION OF COMPLEX STATIC VISUAL SOCIAL STIMULUS

In the ID group's visual scanning patterns nearly the same ratio of task-based and task-independent strategy was found, while a task-based scanning strategy occurred in a significantly larger proportion of persons with TF. A flexible and task-related adaptive strategy use shows a higher variance in the ID group, which sometimes happens but is not considered to be general. This result is consistent with our knowledge of ID, as flexible behavior arrangement and adapting to changing environmental conditions represent serious difficulties for this population (SCHALOCK et al., 2010). According to our results, this is the

case not just in their observable, manifest behavior and cognitive task solving (intelligence), but during the perceptual input on the level of eye movements that significantly affect the level of information intake.

Studying social cognition by scanning the static visual information depicting social stimulus we obtained results in eye movements that can be interpreted for the ID population. The characteristics of scanning saccades and fixation can be compared by groups (compared to gender and age adjusted TF groups) and conditions (social/non-social). In relation to investigation of social cognition it is an important result that during the visual processing of the scene essentially containing social information the ID and TF groups differed significantly in eye movement characteristics, the fixations given to the picture being more scattered in space, and a systematic scanning of the areas relevant to the task (e.g., human heads) being less evident (Fig. 4).



ID Social condition
How long has the visitors been away?

TD Social condition

Fig. 4 Landscape based on fixation duration

CONCLUSION

In the modern approach and services of psychology of special needs (involving diagnosis, development and support) for persons with ID the assessment tools, used in international practice too, work well, in that intelligence and adaptive behavioral profiling are revealing and the results are informative and are in accordance with international published data.

Previous studies and our own research experience show that the application of the eye-tracking technique in research into atypical development requires the solving of a number of specific methodological problems. This, however, is certainly not a hopeless cause, as the eye-tracking technique can contribute significantly to the development of knowledge and practice in special needs education in the future.

The oculomotor (physiological, anatomical and consequently cognitive) limitations (bottom-up) present on the input side and the cognitive limitations (top-down) on the processing side

examinable of the eye-tracking technique, which has proved to be a remarkably robust method of research, supporting the presumption that with modern data collecting equipment valid results can be obtained in samples in which severe problems of vision (and of higher cognitive functions) may occur in significant numbers.

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